

The Afghanistan Engineering Support Program assembled this deliverable. It is an approved, official USAID document. Budget information contained herein is for illustrative purposes. All policy, personal, financial, and procurement sensitive information has been removed. Additional information on the report can be obtained from Firouz Rooyani, Tetra Tech Sr. VP International Operations, (703) 387-2151.

MEMO

To: [REDACTED] USAID

Cc: [REDACTED] USAID

From: [REDACTED]

Date: May 1, 2016

Subject: Temporary Power Supply Arrangement – Arghandi-Ghazni 220kV Transmission Lines, Sayedabad and Ghazni Substations

Under Work Order WO-A-105, Tetra Tech (Tt) has conducted field site visits and prepared this brief technical memo outlining temporary power supply enabling solutions and recommendations for action, for energizing and commissioning the Arghandi-Ghazni 220kV Transmission Line and the two substations – Sayedabad and Ghazni. As requested, we have included consideration of a temporary supply to the Arghandi-Logar 220kV lines in this memo.

Tt's proposed workaround for providing a temporary power supply to the Arghandi-Ghazni 220kV Transmission Line, until the permanent substation facilities at Chimtala and Arghandi are completed, proposes the following:

- a) Build a temporary bypass at Chimtala Substation to connect Chimtala 220kV with one circuit of the new Chimtala-Arghandi 220kV Transmission Line, providing a temporary power supply to the site of the future new Arghandi 220kV Substation (see Attachment 4 - Chimtala Bypass Sketch) and;
- b) Build a temporary bypass around Arghandi Substation to connect to one of the Arghandi-Ghazni 220kV transmission line towers (see Attachment 5 - Arghandi Bypass Sketch). This will provide a temporary 220kV power supply from Chimtala, capable of providing up to 5 MW, to support the Arghandi-Sayedabad-Ghazni project to commission, maintain, and serve load. DABS management supports this concept and has agreed to provide support with any available equipment or manpower. Similarly, the Arghandi-Logar 220kV line can also use this source for commissioning power.

Tt engineers conducted field site visits to the Chimtala Substation area on April 10, 2016, and to the Arghandi Substation area on April 13, 2016. DABS representatives accompanied the Tt team on both site visits. The full site visit report for both sites can be found in Attachment 2 - Arghandi Substation Site Visit Report, and Attachment 3 - Chimtala Substation Site Visit Report.

The results of these field visits demonstrated that the concept of providing temporary power through bypasses at Chimtala and Arghandi is valid. Through the site visits, Tt and DABS identified several concepts to implement the bypass concept.

At a follow-on meeting with DABS and SMEC on April 17, 2016, these concepts were refined and a way forward was identified that is acceptable to DABS technical leadership. The minutes of this meeting can be found in Attachment 1 – DABS/SMEC Meeting Minutes.

Recommended way forward

The following actions are recommended to provide the required temporary power supply

At Chimtala Substation site: Utilize the existing transfer bus to feed one circuit of the Chimtala-Arghandi 220kV Transmission Line through a temporary connection from the end of the transfer bus structure to the existing pull-off tower for the Chimtala-Arghandi line. Use of the Chimtala transfer bus will provide line protection for the Chimtala-Arghandi circuit to the first substation on each of the Arghandi-Logar and Arghandi-Ghazni lines.

For Arghandi Substation site: Make direct 220kV jumper connections from the installed transmission pull-off structure of the Chimtala-Arghandi line to both the Arghandi-Logar and Arghandi-Ghazni lines' pull-off structures. Direct connection of the jumpers between the three circuits at Arghandi without switching is acceptable, considering the facilities are new, the light loading and the temporary nature of the connection.

Risk

DABS ability to install the three remaining structures at Chimtala Substation, needed to complete the Chimtala-Arghandi line, is dependent on quickly resolving remaining LARP ownership issues delaying installation. DABS must then complete construction in time to make the line available for energizing by late August 2016.

DABS leadership assured Tt that the final LARP issues will be resolved in the next few weeks and that construction will be completed by July. DABS must be counted on to achieve this objective, as any alternatives would significantly raise costs.

No other high risk factors have been identified.

Responsibilities for Execution

The following table notes the main activities involved in implementing this proposal and a tentative assignment of responsibility.

Activity	Lead Responsibility	Authorization Method
Initial evaluation of the proposal and development of recommendations	Tt	USAID Work order
Owners Engineer oversight of detail design and implementation of the Proposal	Tt	USAID Work order
Design of the temporary facilities	KEC	DABS contract change order
Supply of construction materials	DABS/KEC/USACE	Depends on donor of materials
Construction of temporary structures and jumpers at both Chimtala and Arghandi. (Future removal not included)	KEC	DABS contract change order
System protection design oversight, commissioning and line energization and operation of the temporary connections	DABS	DABS staff function

Cost

Considering that the completion of the three structures into Chimtala is part of the existing KEC contract scope, and the installation of the three pull-off towers at Arghandi are permanent structures in existing contract scopes, the remaining activities to install the jumpers at Chimtala and Arghandi will constitute the bulk of the new construction cost. The cost to provide adequate temporary line protection at Chimtala is anticipated to be solved by temporary use of a new protection panel borrowed from one of the three projects. USAID's Tt AESP project, and the ADB and USACE projects have equipment of this type. Only one panel is required and when the permanent power supply is available, the panel will be available for its original use.

An estimated Bill of Quantities is provided in Attachment 6. This BOQ includes estimated cost of materials and installation.

An estimated 200 hours of project management and engineering will be required.

Given these considerations, the anticipated cost to implement the proposed temporary connection, including engineering and project management, is anticipated to be approximately [REDACTED]. Availability of materials from existing DABS stock or installation cost reductions could reduce this ROM estimate.

Activity Schedule

Installation of the temporary power supply facilities

Construction of the Chimtala - Arghandi 220kV Transmission Line at Chimtala is expected to be completed in July 2016, according to DABS.

The activities to design the system protection, provide jumpers at Chimtala and provide jumpers at Arghandi are relatively independent activities of short duration. Specific designs and BOQ can be prepared within 60 days of Notice to Proceed (NTP) and installation at each location can proceed independently.

As GPS coordinates for all tower locations for Arghandi Substation pull-off towers have recently been provided, the Arghandi-Ghazni Transmission Line pull-off tower at Arghandi can be installed within 60 days of NTP. It is expected that the Arghandi-Logar Transmission Line pull-off tower installation schedule would be similar. USACE will need to confirm. This will allow the temporary connections to be installed at Arghandi.

Field installation of jumpers at all locations should not require more than 45 days.

Temporary power supply energization should occur in August 2016.

Duration of the temporary connections

At Chimtala the temporary connection will be required until completion of the permanent substation bays. Completion is currently expected by April or May 2017.

At Arghandi the temporary connections will be required until the completion of the Arghandi 220kV substation. Completion is currently expected by the end of 2017.

ATTACHMENTS

Attachment 1 – DABS/SMEC Bypass Meeting Minutes

Attachment 2 – Arghandi Trip Visit Report (April 13, 2016)

Attachment 3 – Chimtala Trip Visit Report (April 10, 2016)

Attachment 4 – Chimtala Bypass Sketch

Attachment 5 – Arghandi Bypass Sketch

Attachment 6 – Bill of Quantities

Attachment 1 – DABS/SMEC Bypass Meeting Minutes

Meeting Minutes

2016-04-17 SMEC and DABS Meeting

Date: 2016-04-17

Location: DABS Headquarter Office

Subject: Chimtala and Arghandi Temporary Bypass Power Supply Meeting

Attendees

No	Name	Organization	Position	Email Address
1		DABS	Head Of Engineering	
2		DABS/PMO	Electrical Engineer	
3		DABS/PIU	Electrical Engineer	
4		DABS/ Relay	Protection Engineer	
5		DABS	Chimtala Substation Manager	
6		SMEC Power & Energy Group Team leader	Team Leader	
7		SMEC	Project Manager	
8		Tt	Deputy Director-Construction Manager	
9		Tt	Director Construction Manager	
10		Tt	Substation Engineer	
11		Tt	DCOP	
12		Tt	Electrical Engineer	
13		Tt	Electrical Engineer	

Meeting started at DABS Headquarters at 09:30 AM

Meeting Agenda – Discussion of temporary solution to power Chimtala and Ghazni substations

Tetra Tech (Tt) thanked the attendees for their participation and provided an overview of the agenda to the meeting participants. The meeting was requested by Tt to discuss mutual actions with all relevant stakeholders to enable a temporary power supply to the new Arghandi-Sayedabad-Ghazni and Arghandi-Logar 220kV transmission lines and substations. This connection will be used beginning in September 2016, to support startup and limited operation of these projects until the substations providing the permanent power supply are available.

The meeting was organized to discuss the technical, operational and project management aspects of how best to provide up to 5MW of temporary power with DABS and DABS Owners Engineer (for Chimtala–Arghandi 220kV transmission line and Arghandi Substation). This approach focuses on connecting one circuit of the new Chimtala-Arghandi 220kV double circuit transmission line at Chimtala substation and a bypass at Arghandi substation site to make a temporary connection to Sayedabad, Ghazni and Logar substations.

After the Tt explanation, meeting attendees shared comments and suggestions detailed below which were directed to achieving the objective defined by Tt.

TEMPORARY POWER CONNECTIONS AT CHIMTALA SUBSTATION

- Direct line connections at Chimtala – The Arghandi substation can be connected directly to one of the incoming lines from Pul-e-Khumri to Chimtala substation. A feature of this solution is that during any fault on the utilized Chimtala – Arghandi – Sayedabad/Logar Transmission Line, the utilized circuit will trip from Pul-e-Khumri through Chimtala to both Logar and Sayedabad-Ghazni substations. DABS Manager for Chimtala Substation noted the tapping solution presently being used at Charikar Substation could possibly be employed. It was agreed that the direct connection is a possible solution, although not the most desirable.
- Chimtala Substation transfer bus connection - The 220kV transfer bus bay in Chimtala substation is another option to connect the Chimtala – Arghandi Transmission Line, but the transfer bus bay will probably need additional protection equipment to protect the transmission line. The possible source of such equipment was discussed. Temporary use of a protection panel from either of the new Sayedabad or Ghazni substations was mentioned as a possibility.
- Tt will inspect Chimtala 220kV transfer Bus protection system, to find a way to add an additional temporary protection panel to protect the Chimtala-Arghandi bypassing transmission line and Chimtala connection point. [REDACTED] noted the station battery voltage is 240 V D.C.
- [REDACTED] stated the Chimtala Substation bays for the permanent connection of the Chimtala-Arghandi 220kV Transmission Line should be ready for service in April or May of 2017.
- There was agreement that use of the Chimtala Substation 220kV transfer bus to connect to one circuit of the Chimtala-Arghandi 220kV transmission line is acceptable to DABS operations, systems protection and DABS Chimtala management to provide up to 5 MW of temporary power to the Arghandi-Sayedabad-Ghazni 220kV transmission lines and the Arghandi-Logar 220kV transmission lines and associated substations.
- The SMEC representative noted that SMEC will start physical construction work in Chimtala substation soon to install the permanent incoming line bay for the Chimtala-Arghandi lines, therefore Tt should be aware and avoid using new bay space for bypassing 220kV transmission line through Chimtala to the 220kV Transfer bus. This does not appear to present any problem.

TEMPORARY POWER CONNECTIONS AT ARGHANDI SUBSTATION SITE

- A sketch was developed and discussed showing a temporary connection between the last structure in the Chimtala-Arghandi 220kV Transmission Line and the Arghandi-Sayedabad-Ghazni and Arghandi-Logar 220kV lines.
- The simple temporary connection schematic to connect the future pull-off towers of all three lines using direct jumpers with no switching or disconnects was reviewed and discussed. If utilized, this will require one intermediate pole for the 2 span +/- 200m long jumper from the Chimtala pull-off structure to the Sayedabad-Ghazni pull-off structure, and a +/-25 m jumper from the Chimtala pull-off structure to the Logar pull-off structure. The SMEC representative agreed to review the bypassing sketch to ensure it was not in conflict with the future Arghandi substation gantries. Initial assessment indicated that no difficulty was foreseen with this issue.
- The use of the direct connection was discussed and in the opinions of DABS and SMEC were that no disconnect or other switching would be necessary because of the newness of the facilities and the light loading and the temporary duration of the connections. This will need to be verified.

COMPLETION OF PERMANENT POWER CONNECTIONS AT CHIMTALA SUBSTATION

- The timing of completion of the three permanent structures to complete the Chimtala-Arghandi 220 kV transmission line into Chimtala Substation was discussed. Completion of this work in time to

make the line continuous by end September 2016 between Chimtala and Arghandi was noted by Tt to be critical to meeting the temporary power requirements.

- DABS representatives informed meeting participants that DABS have already sent a letter to the President about LARP issue of three remaining KEC towers. DABS promised that this issue will be solved and the line completed before the end of July 2016. DABS noted that a letter resolving the issues involved in the LARP situation was expected within one week, and that DABS will either settle with the owners, if ownership is confirmed, or employ the assistance of the authorities to complete the line installation if government ownership is confirmed.
- Tt noted the existing danger to the public of having open excavations at the proposed tower locations. [REDACTED] acknowledged the situation and noted he has notified the contractor.

The meeting ended with general agreement that provision of a temporary 220kV power supply of 5 MW to the Arghandi-Sayedabad-Ghazni 220kV and Arghandi-Logar 220 kV transmission projects by September 2016 using the Chimtala-Arghandi 220 kV Transmission Line is a practical and achievable objective.

Meeting Concluded at: 10:45 AM

Attachment 2 – Arghandi Trip Visit Report (April 13, 2016)



USAID
FROM THE AMERICAN PEOPLE

United States Agency for International Development
Office of Economic Growth and Infrastructure
Afghanistan Engineering Support Program

Site Visit Report	Project: Arghandi-Ghazni 220kV Power Supply (WOA0105)
Location: Kabul Arghandi	Coordinates: Latitude: N 34.472248° Longitude: E 68.951937°
Site Visit Date: April 13, 2016	Report Date: April 17, 2016
Inspectors: Farid Ahmad, Wahabullah and Mohammad Yunas	

PRESENTED TO

United States Agency for International
Development (USAID)
Office of Economic Growth and
Infrastructure (OEGI)

Great Massoud Road
Kabul, Afghanistan

PRESENTED BY

Tetra Tech, Inc.
Afghanistan Engineering Support Program
Contract No. EDH-I-00-08-00027-00
Task Order No. 1

Work Order WO-A-0105 Arghandi-Ghanzi
220kV power supply

Shash Darak
Kabul, Afghanistan

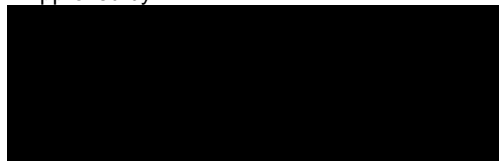
Prepared by:



Name: [Redacted]
Title: **Engineer**

Date:
04/17/2016

Approved by:



Name: [Redacted]
Title: **Director CMS**

Date:
04/19/2016

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

EXECUTIVE SUMMARY

Engineers from Tetra Tech, DABS and Assist Consultants Inc. (ACI) conducted a site visit at Arghandi substation site. The purpose of the site visit was to identify the possibility for a temporary bypass of Arghandi substation for acceptance testing and commissioning of Sayedabad, Ghazni and Logar substations. During the site visit, the engineers did a walk-through of the proposed substation area and transmission line route, took pictures and GPS points, and discussed and evaluated different options. The Arghandi Substation has not been constructed yet; however, the transmission line from Chimtala has reached the location of the proposed Arghandi Substation and the pull-off tower to the future substation has been installed. The pull-off towers on the new transmission lines from Sayedabad and Logar to Arghandi substation have not yet been installed. The connection for temporary power at Arghandi would not be difficult, as it will only require the installation of temporary jumpers between the last tower in the Arghandi-Chimtala transmission line and the Arghandi-Sayedabad and Arghandi-Logar transmission lines, after installation of the last pull-off structures in these two transmission lines.

1.0 SITE VISIT ATTENDEES

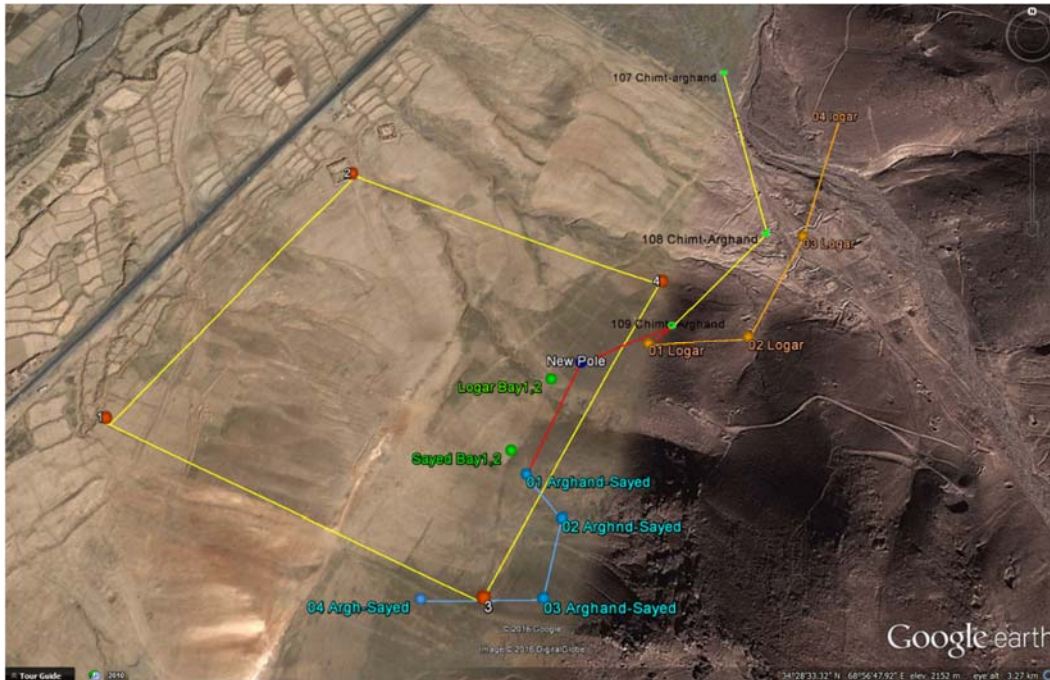
No.	Name	Organization/Department	Position	Phone No.
1		DABS	Survey Engineer	
2		DABS/PMO	Electrical Engineer	
3		ACI/Corps Engineering Contractor	Electrical Engineer	
4		PIU/DABS	Electrical Engineer	
5		DABS	HV Manager	
6		Tetra Tech	Electrical Engineer	
7		Tetra Tech	Civil Engineer	
8		Tetra Tech	Electrical Engineer	

2.0 TRANSMISSION LINE BYPASS

The Arghandi Substation is located to the south of Kabul, on the Kandahar - Kabul highway. The Arghandi Substation is not yet constructed though its location is confirmed. However, it has been confirmed that the Arghandi Substation will not be constructed before Sayedabad and Ghazni substations are ready for commissioning. Therefore, Arghandi Substation must be bypassed in order to provide power for the commissioning of Sayedabad and Ghazni substations. To bypass the Arghandi substation, there is need to erect towers between the incoming line from Chimtala and the out going lines to Sayedabad and Logar substations (see photographs 1, 2, and 3 below).

PHOTOGRAPHS

Photograph 1: Bypass between Chimtala, Logar and Sayed Abad Substations Google Map	2
Photograph 2: Chimtala to Arghandi Dead End Tower	2
Photograph 3: Proposed First Tower Foundation from Arghandi to Logar	3



Photograph 1: Bypass between Chimtala, Logar and Sayedabad Substations (Google map)



Photograph 2: Chimtala to Arghandi Dead End Tower



Photograph 3: Location First Tower Foundation - Arghandi to Logar

Attachment 3 – Chimtala Trip Visit Report (April 10, 2016)



Site Visit Report	Project: WO-A-0105 Arghandi-Ghazni 220kV Power Supply
Location: Kabul Chimtala Substation	Coordinates: Latitude: N 31.608280° Longitude: E 65.769949°
Site Visit Date: 10 April 2016	Report Date: April 17, 2016
Inspectors: Mohammad Yunas, Wahabullah and Farid Ahmad Gailani	

PRESENTED TO

United States Agency for International
Development (USAID)
Office of Economic Growth and
Infrastructure (OEGI)

Great Massoud Road
Kabul, Afghanistan

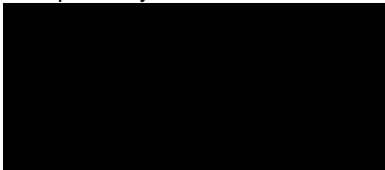
PRESENTED BY

Tetra Tech, Inc.
Afghanistan Engineering Support Program
Contract No. EDH-I-00-08-00027-00
Task Order No. 1

Work Order WO-A-0105

Shash Darak
Kabul, Afghanistan

Prepared by:



Name: [Redacted]
Title: **Engineer**

Date:
04/17/2016

Approved by:



Name **Dick Dumford**
Title: **Director CMS**

Date:
04/17/2016

DISCLAIMER

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EXECUTIVE SUMMARY

Engineers from Tetra Tech (Tt) and DABS conducted a site visit to Chimtala substation on April 10, 2016 to determine how to connect/bypass the Arghandi and Chimtala substations temporarily for test and commissioning of Sayedabad and Ghazni substations. The site visitors discussed and evaluated different options and practically came out through the substation and transmission line route, taking pictures and GPS points. They found three technical and practicable options to complete the incomplete portion of 220kV Chimtala to Arghandi transmission line and a connection point for transmission line in 220kV transfer bus in Chimtala substation.

The following report sections provide details on the outcomes of the site visit

1.0 SITE VISIT ATTENDEES

No.	Name	Organization/Department	Position	Phone No.
1		DABS	Chimtala SS Manager	
2		DABS/PMO	Electrical Engineer	
3		DABS	Relay Engineer	
4		DABS/PIU	Electrical Engineer	
5		DABS	HV Transmission Line Manager	
6		Tetra Tech	Electrical Engineer	
7		Tetra Tech	Civil Engineer	
8		Tetra Tech	Electrical Engineer	

2.0 SITE VISIT DETAILS

On April 10, 2016, a meeting held between Tetra Tech and DABS Engineers at the Chimtala Substation. During the meeting, the following topics were discussed:

1. Chimtala substation bypass
 - a. Jumper connection (T connection) on incomer 220kV transmission line from Pul-e Khumri to Chimtala Substation
 - b. Connection to 220kV Transfer Bus
2. Switching and protection for new connection
 - a. Using the Transfer Bus Coupler Switching system
3. Chimtala-Arghandi 220kV Transmission Line completion options (outlined below in Section 4).

Tt's representative explained to DABS and Chimtala substation engineers the purpose of site visit. This included Tt's proposal to connect Chimtala substation with Arghandi Substation for acceptance testing and commissioning of 220kV Sayedabad and Ghazni substations. Tt proposed three different options to get a connection from Chimtala and for the completion of the Chimtala- Arghandi Transmission Line.

The Chimtala Substation manager recommended that using the 220kV transfer bus is the best option to connect the transmission line, as it has the complete bay and the transfer bus coupler switching and protection system can be utilized.

3.0 TRANSMISSION LINE CONNECTION/BYPASS TO CHIMTALA SUBSTATION

DABS and Tt engineers discussed how to bypass/connect the Chimtala Substation to the Arghandi Substation, and reached agreement that the best option to connect to Chimtala Substation was through the 220kV transfer

bus via existing 220kV incomplete transmission line to Arghandi substation. According to the Chimtala Substation manager, it is possible to use the 220kV transfer bus, which furnished with switching and protection system (see Figures 1, 2, 3, and 4).

4.0 TRANSMISSION LINE COMPLETION

The Tt and DABS engineers' evaluated three options to complete the Chimtala-Arghandi transmission line gap.

4.1 OPTION ONE - COMPLETE THE TRANSMISSION LINE INTO CHIMTALA AS PLANNED

KEC is ready to complete the installation of remaining towers, but the LARP (Land acquisition and resettlement plan) issue do not let them to do it. The DABS engineers present at the site visit stated that DABS' department of government affairs has already started discussion with the reported landowners to solve the land issues and install remaining towers. KEC has erected all but three towers between the Chimtala to Arghandi substations. Foundations have been dug for the remaining towers (T3, T4 and T5). These open foundation holes are unsafe and a pose a hazard for nearby residents, as there is no covering (steel/wooden plates) or safety signs to prevent from a passerby from falling into the open foundations (see Figures 5, 6 and 7).

4.2 OPTION TWO – ALTERNATE ROUTE TO AVOID CURRENT LARP ISSUE

In order to complete the transmission line between Chimtala and Arghandi substations, under this option four more monopole towers need to be constructed, using the three un-installed monopole structures plus an additional fourth monopole on a different route into the Chimtala substation (see route on Figure 8). However, in this option, LARP issues will still exist and DABS will need to quickly resolve them. With option two, monopole number (003) will be installed on its currently planned location, two of the monopoles (P1, P2) will be relocated to the median of the adjacent Kabul-Parma highway right of way, and the third relocated pole (P3) will be installed in a private yard. The perceived benefit this alternate route is that LARP issues would likely be more easily resolved (see Figures 8, 9, and 10). The source of the fourth pole would need to be determined, possibly from spare monopole stock provided under the Chimtala-Arghandi contract.

4.3 OPTION THREE – SECOND ALTERNATE ROUTE USING CONCRETE POLES

LARP issues are the main problem preventing completion of the Chimtala-Arghandi Transmission Line. DABS and Tt brainstormed an option using government land along a small existing West to East street to erect the transmission line poles. In order to avoid LARP issues, DABS and Tt engineers agreed it would be possible to then use the Chimtala substation property along the western boundary wall for the South to North portion of an alternate route for the transmission line. The West to East portion of this proposed route for the transmission line, which will be located on government property, has too small a width (about 10 meters) to use regular towers. Therefore, Tt and DABS recommend the use of spun concrete poles with short span distance to reduce line sag with all conductors installed vertically on the street side of the poles to provide maximum electrical clearance from customer property lines (see route on Figure 11). Acquiring and installing fifteen spun concrete transmission poles, 220kV framing, and conductor installation will all be necessary with this option.

5.0 CONCLUSION

The DABS and Tt team discussed and evaluated all options, and proposes the third option for the temporary completion of the transmission line if the LARP issue with completing as originally designed cannot soon be resolved. This option is preferred as there will not be delay due to LARP issues, since the West to East portion of the alternate transmission route will be on government property, and the South to North portion will be on DABS property. In order to use the government property, consisting of a small street and sidewalk for the West to East portion of the alternate route proposed under this option, DABS should only need to discuss with Kabul Municipality Department to use the street right of way and perform any tree trimming as required. The

connection point in Chimtala substation should be from the transfer bus, as the transfer bus appears to have a complete bay with transfer bus protection and switching system.

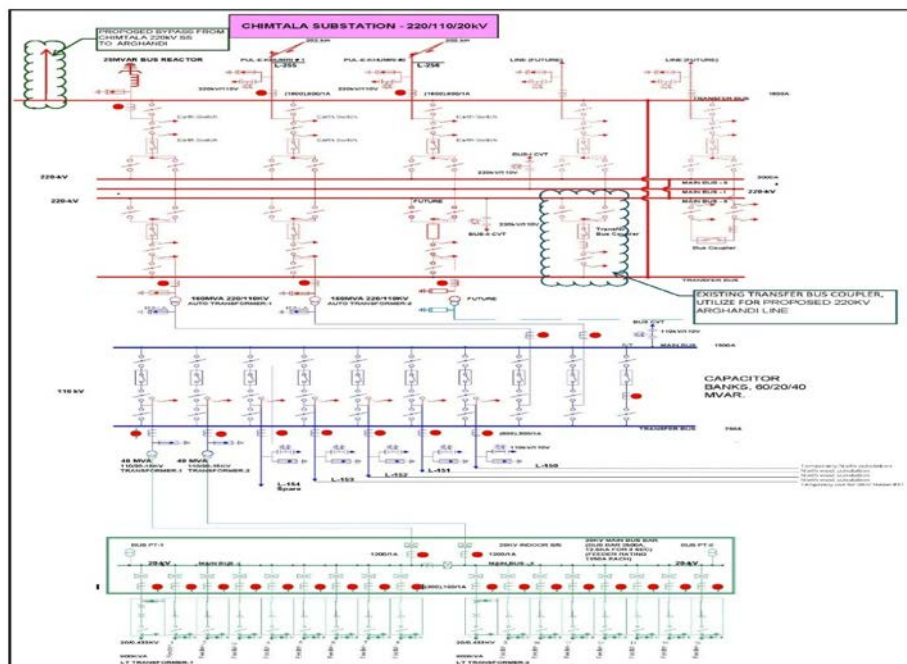
FIGURES

Figure 1: Chimtala Substation Overview	Error! Bookmark not defined.
Figure 2: Chimtala Substation SLD with purposed connection point	Error! Bookmark not defined.
Figure 3: Chimtala Substation Transfer Bus Gantry.....	Error! Bookmark not defined.
Figure 4: Chimtala Substation Transfer Bus Proposed Connection Point	Error! Bookmark not defined.
Figure 5: KEC Tower Plan 220kV Chimtala - Arghandi Transmission Line	Error! Bookmark not defined.
Figure 6: Dead End Tower in Chimtala Substation	Error! Bookmark not defined.
Figure 7: Tower #003 Foundation hole.....	Error! Bookmark not defined.
Figure 8: Second Option Google Map and Transmission Line Rotation	Error! Bookmark not defined.
Figure 9: Second Option Purposed TL Rout	Error! Bookmark not defined.
Figure 10: Second Option Purposed TL Rout	Error! Bookmark not defined.
Figure 11: Third Option - Purposed Transmission Line Rout.....	Error! Bookmark not defined.
Figure 12: Entrance Road to Chimtala Substation	Error! Bookmark not defined.
Figure 13: Sub Road behind Chimtala Substation's boundary wall	Error! Bookmark not defined.

APPENDIX A
SITE VISIT PHOTOGRAPHS AND FIGURES: APRIL 10, 2016



Photograph 1: Chimtala Substation Overview



Photograph 2: Chimtala Substation SLD with proposed connection point.



Photograph 3: Chimtala Substation Transfer Bus Gantry



Photograph 4: Chimtala Substation Transfer Bus Gantry



Photograph 5: KEC Tower Plan 220kV Chimtala - Arghandi Transmission Line.



Photograph 6: Dead End Towers in Chimtala Substation.



Photograph 7: Tower #003 Foundation hole



Photograph 8: Second Option Google Map and Transmission Line Rotation.



Photograph 9: Second Option Purposed TL Rout.



Photograph 10: Second Option Purposed TL Rout.



Photograph 11: Third Option - Purposed Transmission Line Rout.



Photograph 12: Entrance Road to Chimtala Substation



Photograph 13: Sub Road behind Chimtala Substation's boundary wall.

Attachment 4 – Chimtala Bypass Sketch



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Imagery Date: 10/24/2009

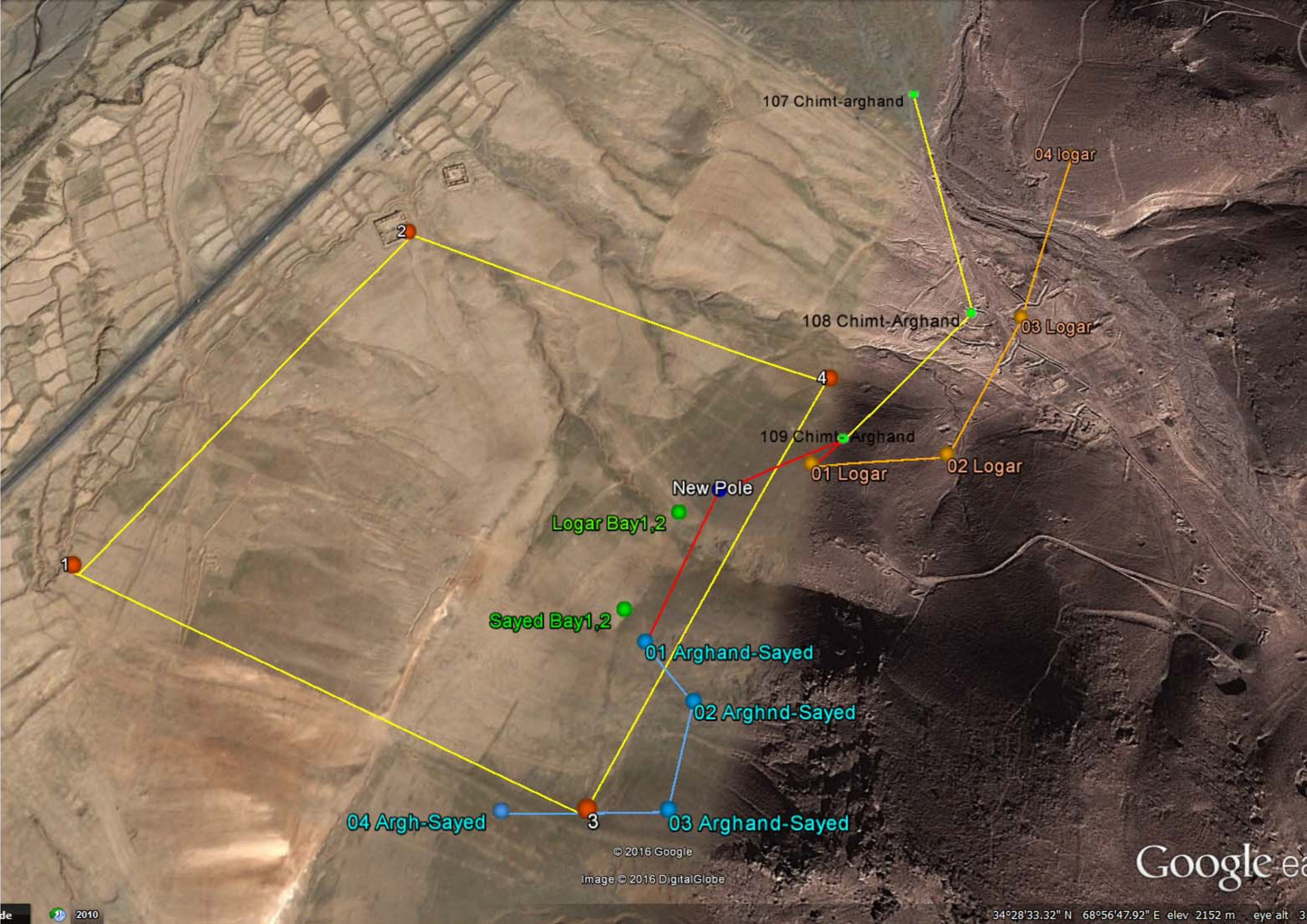
34° 36.944' N 69° 4.678' E elev 1889 m

eye alt



2003

Attachment 5 – Arghandi Bypass Sketch



107 Chimt-arghand

04 logar

108 Chimt-Arghand

03 Logar

109 Chimt-Arghand

01 Logar

02 Logar

New Pole

Logar Bay1,2

Sayed Bay1,2

01 Arghand-Sayed

02 Arghnd-Sayed

03 Arghand-Sayed

04 Argh-Sayed

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Attachment 6 – Bill of Quantities

BYPASS BOQ - QUANTITY AND VALUE			ESTIMATED QUANTITIES				EST. MATERIAL VALUE			EST. INSTALL VALUE		
Item No.	ITEM	UNIT	Chimtala Bypass	Arghandi Bypass	Total Quantity	Anticipated Supply Source	Value Per Unit	Total Materials	Installation	per unit Value	Total Install Value	Total Estimated Cost
1	Wood Pole/hardware assemblies for temporary jumper support	Assy	3	1	4	DABS Stock or KEC Contract			EC Contract			
2	Guys and anchors for temporary jumper support	Assy	3	5	8	DABS Stock or KEC Contract			EC Contract			
3	Temporary bolted clamp dead ends and jumper connectors on steel towers, wood poles, monopole and transfer bus structure.	Assy	12	30	42	DABS Stock or KEC Contract			EC Contract			
4	Conductor for Temporary connections	meter	500	1100	1600	DABS Stock or KEC Contract			EC Contract			
5	Line protection panel	each	1	0	1	Borrow from project			EC Contract			
6	Protection Panel Fixing materials	Lot	1	0	1	DABS Stock or KEC Contract			EC Contract			